

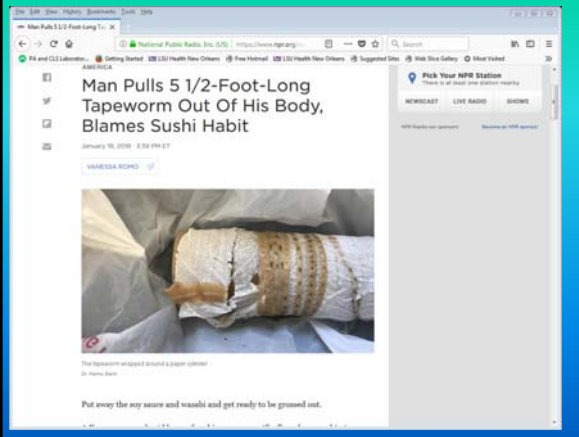


**Parasites & Fungi
in
Recent News**

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Spring 2018 CLPC

Objectives

- Discuss case studies involving various parasites and fungi reported in recent news articles.
- Describe the epidemiology and lab diagnosis for each organism.



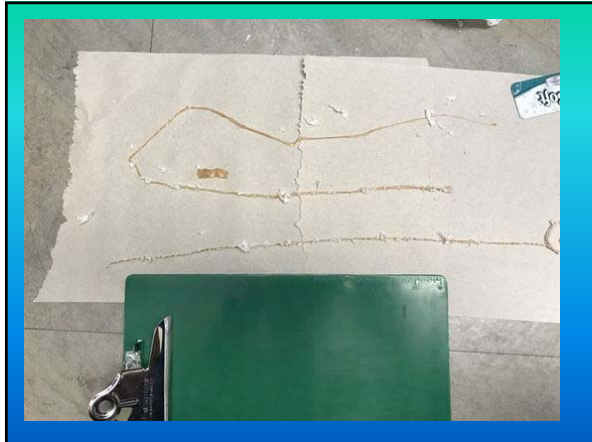
USA Today January 20, 2018

- Young man enters ER in Fresno, California
- Complains of bloody diarrhea & abdominal cramping
- Asks to be treated for worms
- Man hands doctor a plastic grocery bag containing a toilet paper roll



USA Today January 20, 2018

- Patient explains the worm wriggled its way out of him as he sat on the toilet
- He "thought he was dying" & his "guts were coming out"
- He began pulling on the worm until it came out
- Was "relieved" it was a worm
- Measured 5 feet 6 inches (longest on record was 40 feet long)



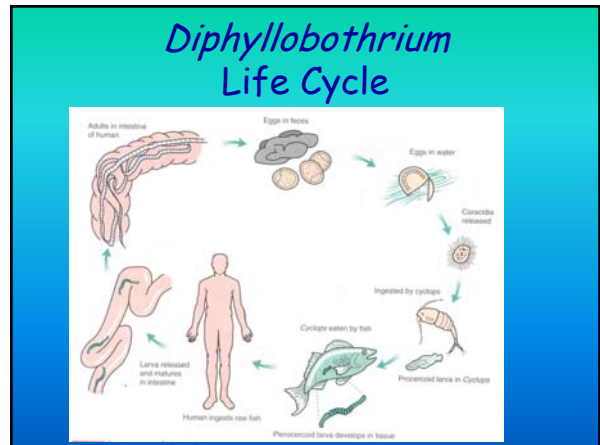
USA Today January 20, 2018

- Patient reported no trips abroad or drinking any questionable water
- Confessed his deep love of salmon sashimi
- Eats raw salmon almost everyday




Japanese Tapeworm

- *Diphyllobothrium* sp.
- Broad tapeworm
- Prevalent in Alaska
 - CDC study in 2017 found salmon infected with Japanese tapeworm
- Requires 2 intermediate hosts
 - Copepod (water flea)
 - Fish

Adult Morphology

- May measure up to 10 meters long
- Scolex is elongate & spoon-shaped; contains two sucking grooves
- Proglottids (segments) are broad




Clinical Disease & Diagnosis

- Usually minor symptoms: abdominal discomfort, weight loss, weakness
- Vitamin B₁₂ deficiency
- Eggs &/or proglottids found in stool
- Proglottids are passed in chains of a few inches to several feet long

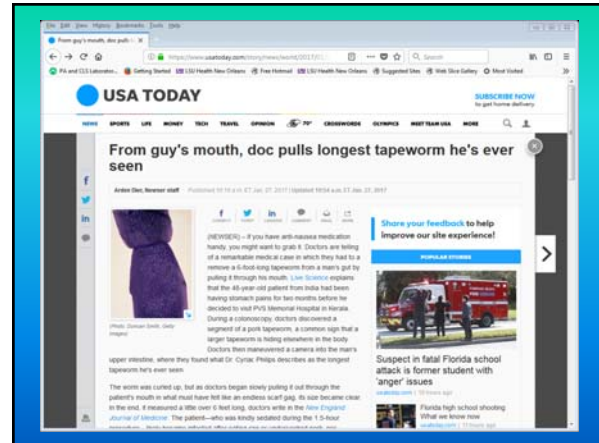
Treatment



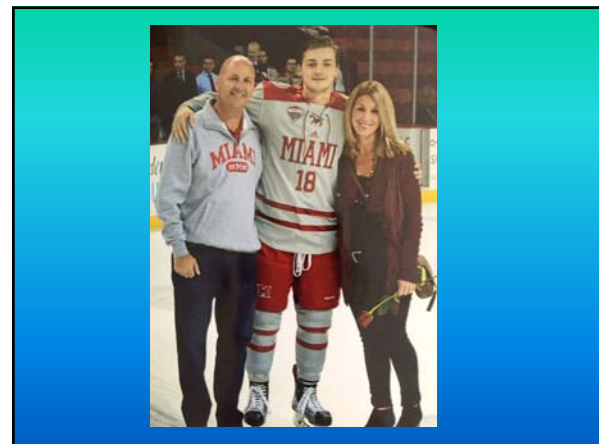
- Praziquantel
- Albendazole
- Medication depends on species of tapeworm
- Drugs target the adult, not the eggs
- Important not to be reinfected
- Handwashing very important

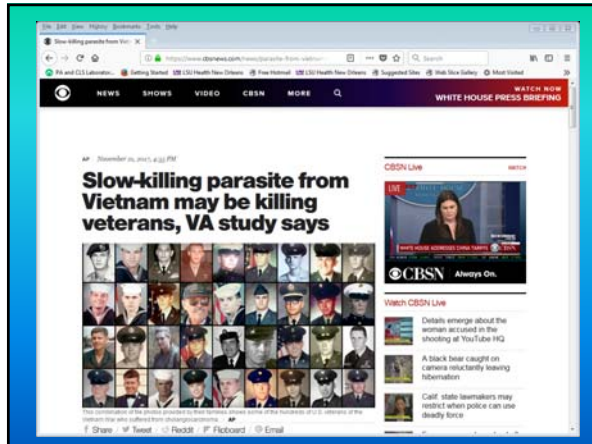
Japanese Tapeworm

- Only about 2,000 cases reported in humans (mostly in northeastern Asia)
- Pork & beef tapeworms more common in U.S.
 - Caused by *Taenia* species
 - Estimated less than 1,000 cases/year



May 24, 2018






CBS News November 21, 2017

- Dept. of Veterans Affairs
- Conducting study to determine if there is a link between liver flukes & bile duct cancer
- 700 veterans with cholangiocarcinoma have been seen by the VA in past 15 years
- At least 20% of blood samples submitted were + for liver fluke antibodies
 - Performed at Seoul National University in South Korea


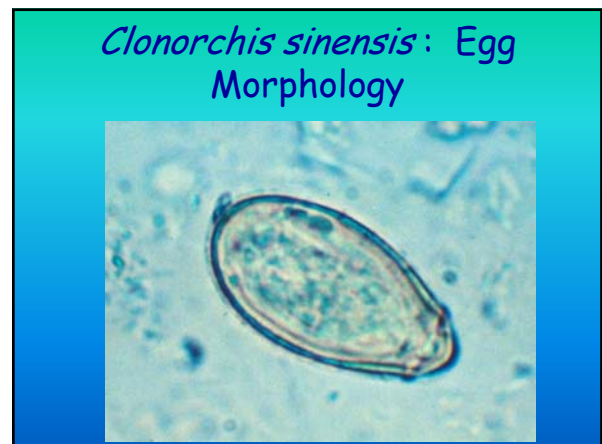
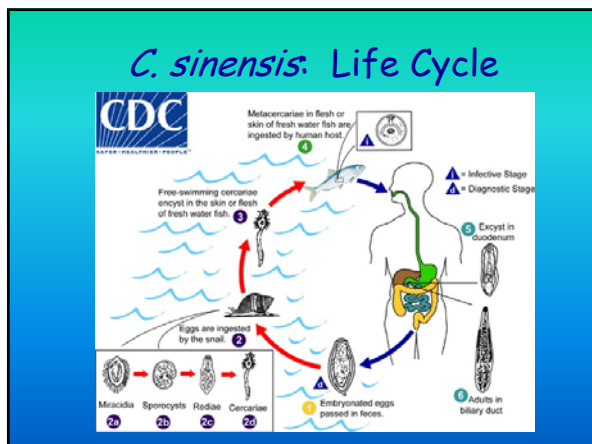
CBS News November 21, 2017

- 69 year old male in New York
- Participated in study
- No symptoms, wanted to help save lives
- Discovered 2 cysts on his bile duct
 - Potential to develop into cancer
- Cysts removed; doing well
- Most likely acquired from uncooked fish he ate in Vietnam when his unit ran out of rations in the jungle



Liver Fluke

- *Clonorchis sinensis*
- Rarely found in Americans
- Infects about 25 million people worldwide
- Endemic in rivers of Vietnam
- Intermediate hosts:
 - Snail
 - Fish

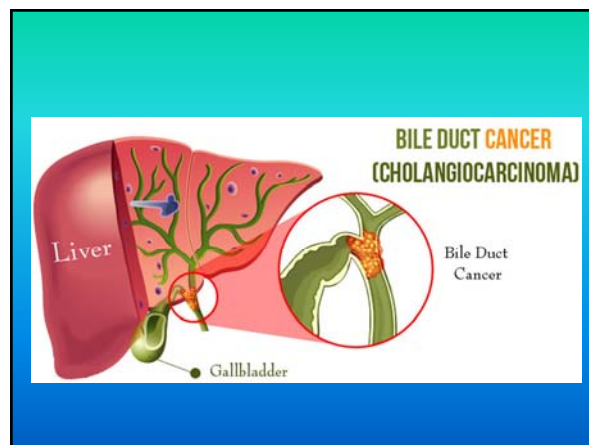
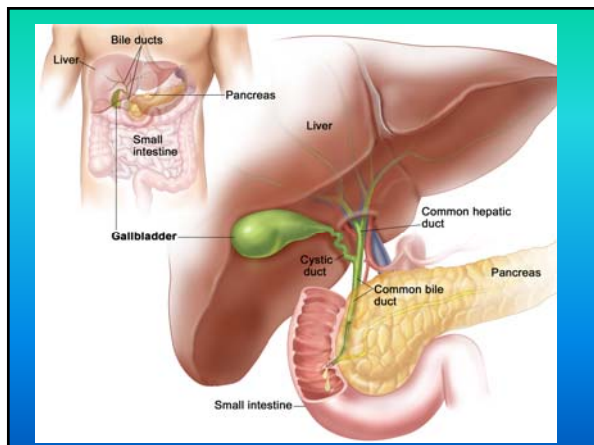



Preserved liver flukes Siriraj Hospital in Bangkok, Thailand



C. sinensis: Clinical Disease

- Symptoms:
 - Indigestion, abdominal pain
 - Malnutrition
 - Swelling, inflammation &/or obstruction of bile ducts
 - Cirrhosis of liver
- Linked to neoplasms of bile duct (cholangiocarcinoma)
 - Jaundice, abdominal pain, dark urine, fever, itchy skin, vomiting & unexplained weight loss



C. sinensis: Diagnosis

- Patient history
- Recovery of eggs in stool or biliary contents
 - Unlikely in persons whose only exposure took place more than 25-30 years ago
 - Liver fluke must be alive to produce eggs
- Cysts can be detected by ultrasound, CT, or MRI
- No test to link liver fluke infection to cholangiocarcinoma

Treatment

- Praziquantel
- Albendazole
- If left untreated, flukes can live for decades without making host sick



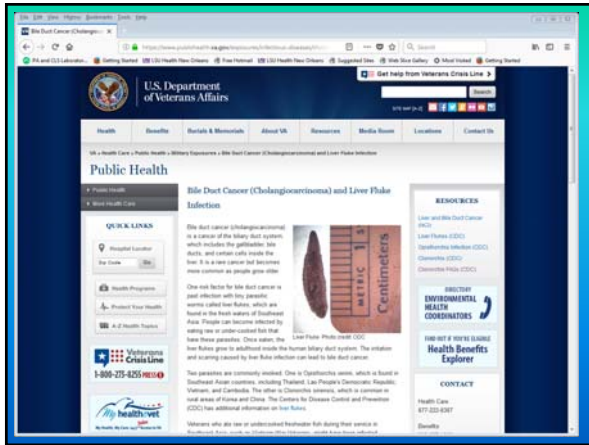
VA Study

- 700 veterans with cholangiocarcinoma seen by VA in past 15 years
- Less than half submitted claims for service-related benefits
 - Not aware of possible connection to Vietnam
- VA rejected 80% of requests
 - Decisions made haphazardly
 - Depended on what desk it landed on



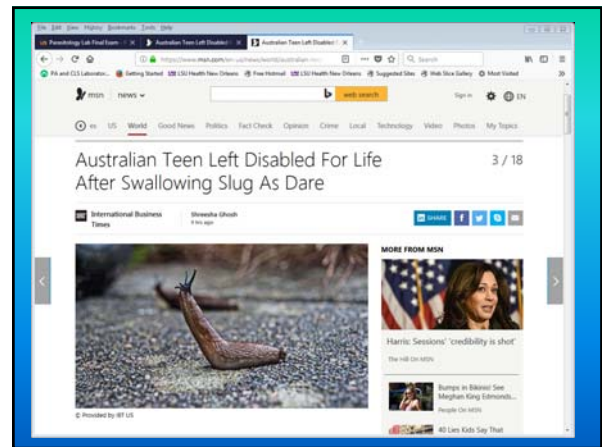
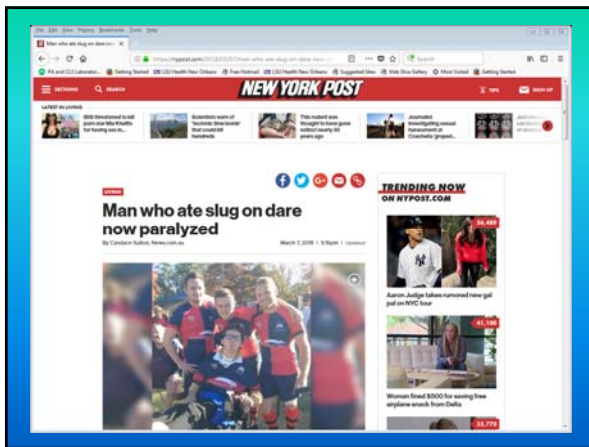
VA Study

- Congress is researching the study & raising more awareness about liver flukes
- Vietnam veterans encouraged to have an ultrasound to detect inflammation of the bile duct
- Government recently posted a warning on its website
 - “Veterans who ate raw or undercooked freshwater fish while in Vietnam might have been infected.”



VA Study

- 65 year old veteran
- Claim was granted after being denied 3 times
 - Bile duct cancer “more likely than not” caused by liver flukes
- Doctor had to write letter
 - “Those affected by Agent Orange automatically receive benefits”
- “We have to fight to receive help due to lack of awareness”





New York Post March 7, 2018

- 19 year old male rugby player
- Sydney, Australia
- At birthday party with friends
- Sitting around table drinking red wine
- Garden slug noticed; was dared to eat it; he did
- Began feeling ill; taken to hospital



New York Post March 7, 2018

- Diagnosed with eosinophilic meningo-encephalitis
- Lapsed into coma for 420 days
- Paralyzed below the neck
- Released from hospital 3 years later in motorized wheelchair

New York Post March 7, 2018

- 8 years later:
 - Requires 24 hour care
 - Lives with tracheostomy tube
 - Experiences consistent seizures
 - Cannot control his body temperature
- Recently told that his benefits package was cut significantly

New York Post March 7, 2018

- Australia's National Disability Insurance Scheme (NDIS)
 - Government run office
 - Deals with patients who are incapacitated & require monetary assistance for therapeutic/psychological well-being & care
- Family is facing huge debts & could lose many services
- Fighting to keep his benefits

Angiostrongylus cantonensis

- Cause of patient's meningoencephalitis
 - Rat lungworm
 - Parasite typically infects rats
 - Can infect people who consume infected snails/slugs not properly cooked
 - Slugs become infected after ingesting feces of infected rats
 - May also be found in frogs, freshwater shrimp & land crabs
 - "Barber pole" appearance

Angiostrongylus cantonensis



Angiostrongylus cantonensis



Angiostrongylus cantonensis

• Life Cycle:

- Host is common Norway rat
- Parasite found in lungs of rat, which excretes larvae in its feces
- Snail & slugs are intermediate hosts, picking up larvae & excreting them in slime trails
- Often crawl across vegetables, infecting human food sources



Clinical Disease

- Incubation period
 - Usually 1-3 weeks
 - Can range from 1 day to greater than 6 weeks
- Symptoms
 - Throbbing headache
 - Stiff neck
 - Fever
 - Nausea/vomiting
 - Abnormal sensations of the arms & legs

Clinical Disease

- Severity of disease depends on number of larvae ingested & age of patient
 - Illness usually lasts 2-8 weeks
- Some people exhibit very mild symptoms



Diagnosis


- Can be difficult
 - No available blood tests
- Patient history very important
 - Travel
 - Ingestion of raw/undercooked snails/slugs
- Eosinophilic meningitis
 - High levels of eosinophils in blood or CSF
 - Usually >10%
 - Lack of neutrophils (rules out bacterial meningitis)



Treatment

- No specific treatment
- Antihelminthic agents & corticosteroids
 - Remains controversial
 - Many studies found that prednisone helped relieve headaches & shortened the duration of the illness




The Advocate,
March 22, 2000 

- ANIMAL HEALTH:
- "Pacific area parasite creeping across state"
 - Microscopic parasite carried by rats & snails
 - Invaded south Louisiana
 - Killed zoo animals in N.O. & Lafayette
 - Infected horses, and one human

Angiostrongylus cantonensis

- Endemic in the United States
- Believed to arrive in LA through rats on ships docked along Miss. River
- First discovered in LA by Tulane Medical Center researchers who often survey wharf rats, looking for tropical diseases



Angiostrongylus cantonensis

- 1993: First documented case of human infection in LA
 - Occurred in New Orleans
 - 11 year old boy infected after eating a snail on a dare
 - Treated at Children's Hospital
 - CSF revealed 215 WBC's (16% eosinophils)
 - Recovered completely




Angiostrongylus cantonensis


- 1998: Zoo of Acadiana, Lafayette
 - Red lemur found dead
 - Had displayed signs of neurological trouble
 - Cage in shady, damp area (environment snails & slugs like)
 - Parasite found in lemur's spinal cord



Survey Conducted

- September, 1997 - September, 1998:
 - East BR Parish Rodent Abatement District
 - 113 rats trapped behind area grocery stores
 - 48% tested positive for *A. cantonensis*



Audubon Zoo New Orleans 





- After 6 animals were infected & some died, officials decided to have occasional "slugathons" by volunteers
 - One year, top collector gathered over 400 slugs & snails
- Since program began, no other cases of infection have been recorded

Apple Snails



- Native to South America
- Introduced to SE United States through aquarium trade
- Found in lakes, rivers, streams, ponds & ditches
- Have negative impact on wetlands, agricultural crops & human health
- Can produce thousands of eggs/month in bright pink masses

Apple Snails

Geographical Map



Pomacea maculata

Map created on 8/2/2017 United States Geological Survey

Apple Snail "Roundup" Mobile Bay, Alabama





Apple Snail Eggs





Angiostrongylus cantonensis

- March, 2006
- 22 year old in Lafourche Parish
- Hospitalized with neck pain, back aches & hypersensitivity to touch
- CSF revealed 304 WBC's/uL with 36% eosinophils
- Diagnosed with eosinophilic meningitis
- 9 days prior to onset of symptoms, he had eaten (on a dare) 2 raw legs from a green tree frog



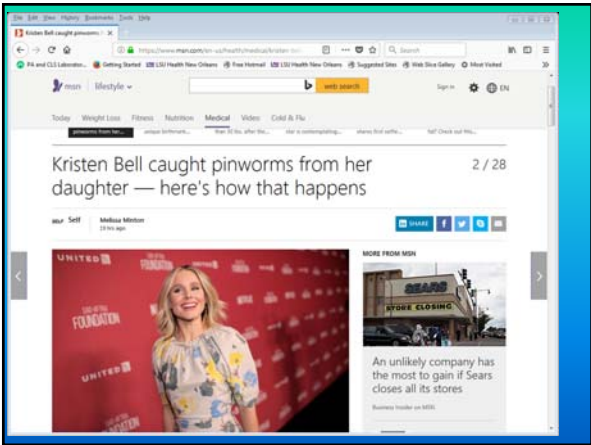
Outbreak News Today September 28, 2017



- Infant in Hawaii
- Hospitalized after accidentally consuming a slug/snail
- 17th case of Angiostrongyliasis
 - Hawaii State Dept. of Health (DOH)

Outbreak News Today September 28, 2017


- Hawaii Island Health Officer
 - Reminds parents to watch infants & toddlers when playing on ground
 - Help children properly wash hands
 - Inspect & wash all fruits & vegetables
 - Control snail/slug population in home gardens
 - Farmers should control snail/slugs & rats on farms



Kristen Bell

- Revealed she caught pinworms from her 3 year old daughter
- Noticed that all carpeting at the preschool was gone
- Asked about it & was told that there was a case of pinworms
- Soon after, noticed her daughter was scratching her anal area - knew there was a problem!


Kristen Bell

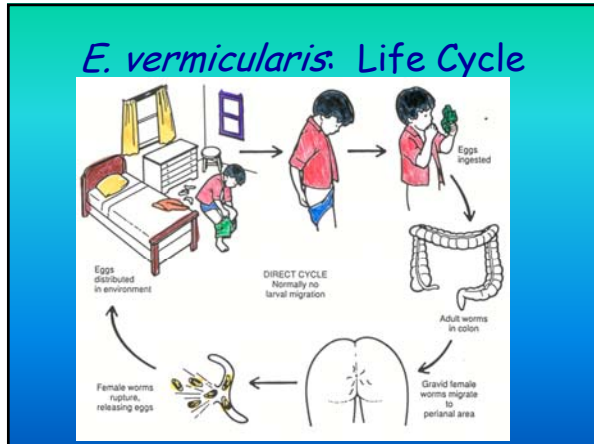


- Later that day, she felt "the itch"
- She wiped and saw a little white worm
- Then came a family round of "chalky nonsense from the drugstore"
- Eventually an end to the worms' reign of terror in their household!

Pinworm infection

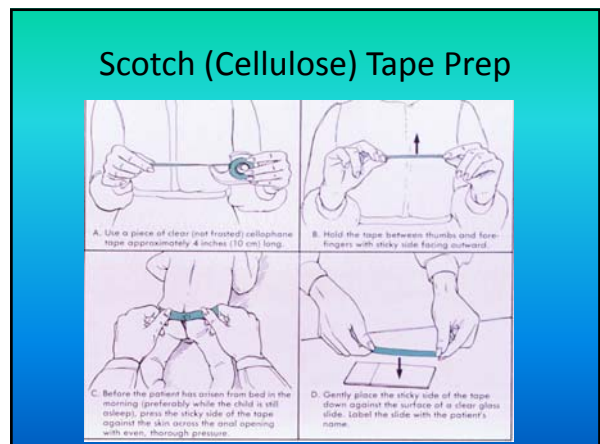
- Caused by *Enterobius vermicularis*
- Most common nematode infection in the world
- Very common in children
 - School classrooms & cafeteria
 - Daycare facilities





- ### *E. vermicularis*: Clinical Disease
- Non-invasive organism
 - Most common symptom - Perianal itching (pruritis)
 - Transmitted by:
 - Direct anus to mouth contamination
 - Sleeping in same bed as carrier
 - Airborne eggs inhaled or swallowed

- ### *E. vermicularis*: Diagnosis
- Eggs in stool, perianal scrapings, or scotch tape prep
 - Adult worm in stool
-

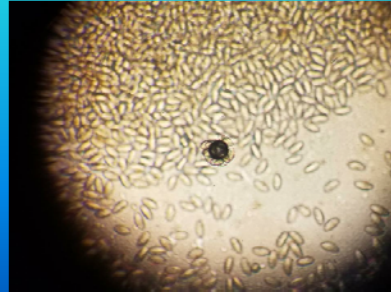


Scotch (Cellulose) Tape Prep

- Best method for diagnosis
- Series of 4-6 preps may be necessary to receive a positive result
- Optimal sample taken after patient has been sleeping for several hours or immediately upon waking



Pinworm infection - 15 month old (Lafayette hospital)

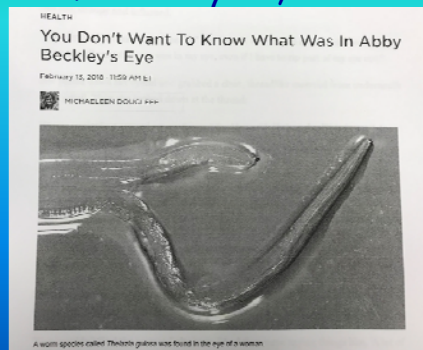


Enterobius vermicularis: Prevention & Treatment

- Total prevention not realistic
 - Short, clean fingernails
 - Closed sleeping garments
- Treatment
 - Mebendazole, Albendazole
 - Over the counter treatments



CNN Health February 13, 2018



CNN Health February 13, 2018

- 26 year old college student
- Lives on a cattle ranch in Oregon
- Salmon fishing in Alaska
- Began feeling a sensation of something in her eye
- Persisted for about 5 days
- Went to mirror & pulled out a clear thread from her eye
- It was squiggling around on her finger!



CNN Health February 13, 2018



CNN Health February 13, 2018

- Initially thought it was from the salmon
- Removed 4 more worms before she could see an eye doctor
- They didn't believe her; couldn't see any worms
- An hour later, they finally saw one; started screaming!

CNN Health February 13, 2018

- Returned to Oregon to see her ophthalmologist
- He sent some of the worms to CDC
- Parasitologist ruled out all other "eye worms"
- Finally diagnosed as *Thelazia gulosa*, the cattle eye worm
- Never reported in people before
 - Had to refer to a 1928 reference written in German
- Case recently published in *American Journal of Tropical Medicine and Hygiene*

Thelazia gulosa Life cycle

- Worms live on surface of a cow's eye
- Mate & produce larvae
- Causes pus to pour out of cow's eye
- A fly lands on pus & ingests larvae
- Larvae develops in fly then are released back into another cow's eye (or human eye in this case)
- Unable to survive without fly



Thelazia gulosa



Thelazia gulosa

- Over a few weeks, collected 14 worms from her eye
- Patient made full recovery
- No permanent scarring in eye
- No lingering psychological scars
- Prognosis not very good for cattle
 - Worms stay in eye much longer & cause permanent scarring & blindness





Fox News January 28, 2018



- Couple from Canada
 - 22 year old female; 25 year old male
- Vacationing in the Dominican Republic
- Experienced "incredibly itchy" feet after strolling on the beach
- Assumed it was due to sand fleas
- Worsened each day

Fox News January 28, 2018

- Returned home to Canada
- Developed painful swelling & blisters
- Could not tolerate shoes or socks & used crutches to walk
- Multiple visits to hospital; misdiagnosed twice
- Third doctor identified the problem as cutaneous larva migrans caused by hookworm larvae

Cutaneous Larva Migrans

- Caused by a hookworm of dogs & cats
- *Ancylostoma braziliense/caninum*
- Also referred to as "creeping eruption"
- Method of Infection:
 - Larvae in soil or sand penetrate skin
 - Papule forms & develops into linear tracts as larvae migrates through tissues

Initial infection



Linear tracts



Ancylostoma braziliense/caninum

- Lives in the intestines of dogs & cats
- Larvae burrow through human skin when in contact with sand/soil contaminated with animal feces
- Diagnosis
 - Patient history
 - Characteristic linear tracts
 - No serological tests

Treatment



- Couple prescribed Ivermectin
 - Anti-parasitic drug
- Canada's public health dept. denied medication request
 - Not licensed in Canada
- The male's mother drove over the Canadian-US border to Detroit to pick up the Ivermectin

Prevention



- Wear shoes when walking in sand
- Don't assume glamorous beach resorts are not at risk
 - Ask if private beach with no dogs allowed
- If symptoms occur (itchy feet), seek medical attention immediately



State health officials warn of increase in valley fever



BAKERSFIELD, Calif. (KBIA/KBF) — Valley fever numbers are way up in California.

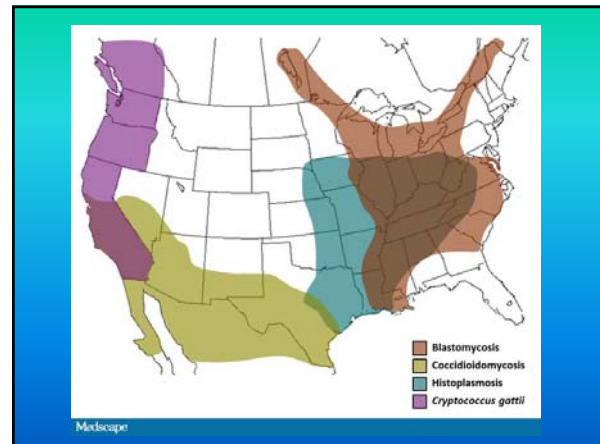
State health officials say this year is looking to be the worst on

Bakersfield, CA News March 29, 2018

- Valley fever cases have dramatically increased in California
 - Highest on record
 - 34% increase in cases between 2016 and 2017
 - Expecting an increase this year too
- Cases more common in late summer & fall
- Important for people living, working &/or traveling to California to be aware of its symptoms

Coccidioides immitis

- Causative agent of coccidioidomycosis
- Also known as valley fever
- Endemic in southwest U.S. (semiarid areas with hot summers, wet winters & infrequent frosts - deserts)
- Spores grow in the soil
- Infection is acquired by inhalation of spores



Clinical Disease

- Most virulent of all human fungal agents (inhalation of only a few spores produces disease)
- Incubation is 7-28 days
- Symptoms include fever, malaise, dry cough, chest pain, night sweats & anorexia (flu-like)
- Most cases resolve in 3 weeks to 3 months
- Can become disseminated

Laboratory Diagnosis

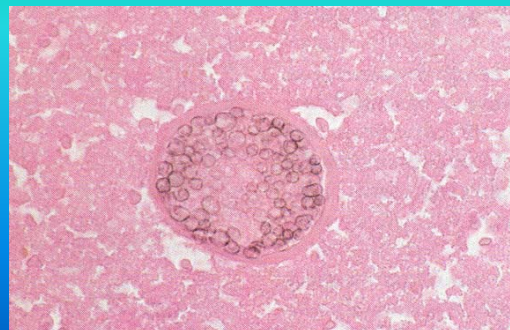
- Variety of specimens
 - Sputum
 - Tracheal aspirate
 - Lung biopsy
 - CSF
 - Blood culture



Laboratory Diagnosis

- Direct Examination (KOH)
 - Reveals non-budding, thick-walled spherules containing endospores (after inhalation of arthroconidia, convert to spherules) - unique to this organism
 - Often confused with *Blastomyces dermatitidis* & *Cryptococcus neoformans*

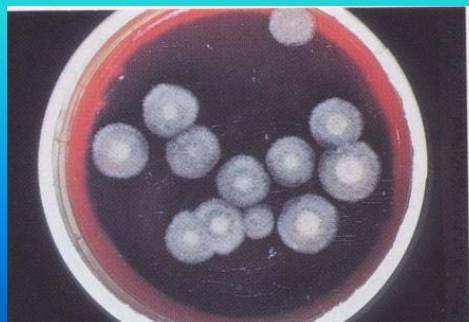
Coccidioides immitis



Laboratory Diagnosis

- Culture
 - Rapid growing (3-7 days)
 - Young culture is cobweb-like; colony enlarges in a circular "bloom"
 - Microscopic: characteristic alternating arthroconidia (septation of hyphae that exhibits empty spaces between barrel-shaped arthroconidia)
 - Dangerous to handle in the lab without biological safety cabinet

Coccidioides immitis



Coccidioides immitis



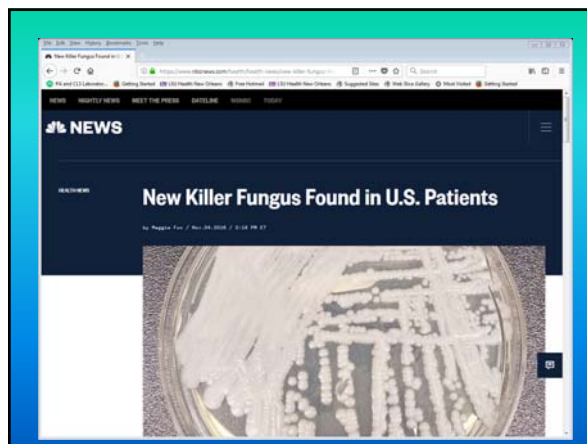
New Rapid Detection

- U.S. Food & Drug Administration
 - Regulatory clearance for molecular assay
 - Decreases diagnosis time
 - Same day instead of up to 21 days
 - No culture testing (eliminates exposure of lab personnel to highly infectious agent)



Prevention

- Stay inside when windy & air is dusty
- Keep windows & doors closed
- Wear properly fitted mask when outdoors
- Keep from disturbing soil
 - No leaf blowers
- Construction sites should take special precautions to protect workers



NBC News November 4, 2016

- Newly identified fungus found in U.S. hospitals
- *Candida auris*
- Opportunistic yeast
- Can kill very sick patients
- First identified in 2009 in a Japanese patient with an ear infection

Candida auris

- June 2016
 - CDC asked doctors to begin looking for it
 - Found 13 cases over the summer
 - 4 patients died
 - 1 brain tumor; 2 blood cancer; 1 respiratory failure
 - Some strains were resistant to all antifungal drugs
 - Difficult to identify
 - Often mis-diagnosed as other yeasts

Candida auris

- Appears to have arrived in U.S. in past few years
- CDC trying to understand how it spreads
- Organism found throughout the body and on the skin
 - Enters bloodstream through wounds, ventilators, or catheters
- Considered an emerging threat by CDC

Candida auris

- At least 30% of infected persons in the U.S. have died
- Acts more like a nosocomial bacteria
- Mainly a hospital-acquired infection
- Healthy persons not usually at risk



Health Science
Could A Rare, Deadly 'Superbug' Fungus Be Gaining A Foothold?

By David Thal, Medill News Service February 12, 2018

The number of U.S. patients infected with a rare but dangerous fungal "superbug" called *Candida auris* has climbed quickly to 200 as of Dec. 31, according to the latest figures from the federal Centers for Disease Control and Prevention.

In 2016, there were only seven cases of the multidrug-resistant infection on the national radar.

CANDIDA AURIS: RISE OF A FUNGAL SUPERBUG

Washington Post February 12, 2018

- CDC reports:
 - "Number of U.S. patients infected with rare, but dangerous fungal "superbug" climbs to 200 as of Dec. 31"
 - Most cases (123) reported in New York; followed by New Jersey (48)




Washington Post February 12, 2018

- Wide variety of organisms in the yeast family
- Usually cause minor infections
 - Athlete's foot
 - Nail infections
 - Oral thrush
 - Vaginal yeast infections
- *Candida auris* can attack organs & is resistant to many medications

Candida auris


- Transmitted easily between patients
 - Contact with contaminated surfaces
 - Person to person contact
- CDC recommends thoroughly cleaning hospital rooms with bleach and UV light
- Important to protect vulnerable patients
- Symptoms: fever & chills that don't improve with antibiotics

Candida auris culture




Diagnosis

- U.S. FDA recently authorized first test to identify *Candida auris*
 - MALDI-TOF
 - Technology known as matrix-assisted laser desorption/ionization time of flight
 - Mass spectrometry
 - Molecular identification
 - Reference organism database



Treatment

- CDC recommends concurrent treatment with 3 antifungal drugs:
 - Anidulafungin
 - Caspofungin
 - Micafungin
- Belong to a new class of antifungal drugs (echinocandins)
- Infections in the U.S. have been successful with this protocol



Candida auris

- Recommendations to medical facilities & laboratories
 - Continue to report cases
 - Forward isolates not identified using common methods to state/local health authorities & CDC
- CDC continues to study risk factors, transmission, & infection control

